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# D E C I S I O N
## of 22 February 1996

**Case Number:** T 0642/92 - 3.3.3

**Application Number:** 88105894.5

**Publication Number:** 0288823

**IPC:** C08G 18/76

**Language of the proceedings:** EN

**Title of invention:**
Process for the preparation of polyisocyanate prepolymers and polyurethanes having high temperature performance and low hysteresis

**Applicant:**
AIR PRODUCTS AND CHEMICALS, INC.

**Opponent:**
-

**Headword:**
-

**Relevant legal provisions:**
EPC Art. 54, 56, 84, 117, 133, 134

**Keyword:**
"Novelty (yes) - after amendments"
"Inventive step (no) - obvious combination of known features"
"Clarity (yes) - product features deriving inherently from process features"
"Representation - pending the relevant cases before the Enlarged Board, Articles 133 and 134 EPC are to be followed"
"Evidence within the context of Article 117 EPC in effect means all the legal means excluding mere argument that tends to prove or to disprove a fact at issue before the Board"

**Catchword:**
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

**Case Number:** T 0642/92 - 3.3.3

**D E C I S I O N**
**of the Technical Board of Appeal 3.3.3**
**of 22 February 1996**

**Appellant:** AIR PROCUCTS AND CHEMICALS, INC.
Route No. 222
Trexlertown
Pennsylvania 18087 (US)

**Representative:** Schwabe - Sandmair - Marx
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**Decision under appeal:** **Decision of the Examining Division of the European Patent Office posted 17 February 1992 refusing European patent application No. 88 105 894.5 pursuant to Article 97(1) EPC.**

**Composition of the Board:**

**Chairman:** C. Gérardin
**Members:** B. ter Laan
J. Stephens-Ofner

## Summary of Facts and Submissions

I. European patent application No. 88 105 894.5, filed on 13 April 1988, claiming priority from an earlier application in the United States (US 38810 of 15 April 1987), and published on 2 November 1988 under publication No. 0 288 823, was refused by a decision of the Examining Division of the European Patent Office dated 17 February 1992.

The decision was based on a set of 19 claims filed on 2 February 1991 (of which Claim 14 was amended in a letter dated 16 July 1991), Claim 1 reading as follows:

"Process for producing a prepolymer reaction product comprising a prepolymer suited for producing polyurethane/urea elastomers wherein toluene diisocyanate is reacted with a long chain polyol to produce a prepolymer, and the prepolymer is reacted with an aromatic diamine to form a polyurethane/urea elastomer, which process comprises:

(a) reacting an isomer mixture of 2,4- and 2,6-toluenediisocyanate with a long chain polyol at a temperature from about 0 to 90°C at a mole ratio of toluenediisocyanate to long chain polyol from 4 to 20:1, with the level and ratio of 2,4- to 2,6-toluenediisocyanate in said isomer mixture being adjusted such that the prepolymer reaction product contains from 65 to 85% by weight of reacted 2,4-toluenediisocyanate isomer-derived units and from 15 to 35% by weight of reacted 2,6-toluenediisocyanate isomer-derived units, based on reacted toluenediisocyanate, and that at least about 90% of such prepolymer reaction product consists of a prepolymer of 2 moles toluenediisocyanate per mole of long chain polyol; and

(b) removing unreacted toluenediisocyanate from the prepolymer reaction product comprising prepolymer to a level of less than about 0.15%."

Dependent Claims 2 to 10 referred to preferred embodiments of Claim 1. Independent Claim 11 was directed to a:

"Prepolymer comprising toluenediisocyanate and a long chain polyol wherein the actual isocyanate content is at least 90% of the stoichiometric level of isocyanate for a prepolymer having a 2:1 mole ratio of toluenediisocyanate to long chain polyol, and wherein the unreacted toluenediisocyanate level is less than 0.15%."

Dependent Claims 12 to 14 referred to preferred embodiments of Claim 11.

Claim 15 was also independent and read:

"A toluenediisocyanate end-capped prepolymer reaction product formed by the reaction of an isomer mixture of 2,4- and 2,6-toluenediisocyanate and a long chain polyol at a temperature from about 0 to 90°C at a mole ratio of toluenediisocyanate to long chain polyol from about 4 to 10:1 with the level and ratio of 2,4- to 2,6-toluenediisocyanate in said isomer mixture being adjusted such that the reaction product contains from 65 to 85% by weight of reacted 2,4-toluenediisocyanate isomer-derived units and 15 to 35% by weight of reacted 2,6-toluenediisocyanate isomer-derived units, based on reacted toluenediisocyanate, and wherein at least about 90% of such prepolymer reaction product consists of a prepolymer of 2 moles reacted toluenediisocyanate per

mole of long chain polyol, and further, said prepolymer reaction product having an unreacted toluenediisocyanate content of less than about 0.1% by weight of said prepolymer reaction product."

Claim 16 referred to a process for manufacturing a polyurethane/urea elastomer in which a prepolymer reaction product of any of Claims 11 to 15 was reacted with an aromatic diamine.

Dependent Claims 17 and 18 were directed to preferred embodiments of Claim 16.

Claim 19 referred to a polyurethane/urea elastomer obtained by the process of any of Claims 16 to 18.

II. The reason given for refusal was lack of novelty of the subject-matter as defined in claim 11. More specifically, it was held that DE-A-3 200 412 (D1) disclosed a prepolymer of toluenediisocyanate (hereinafter "TDI") having a structure close to the ratio 2:1 of TDI to long chain polyol and containing less than 0.05% by weight of unreacted diisocyanate. Although these prepolymers, after having been prepared, were mixed with further diisocyanates, the fact remained that the prepolymers as such, as claimed in Claim 11, without any specification of the ratio of reacted 2,4- and 2,6-TDI isomers, had been described by D1.

Although the decision was solely based upon the above-mentioned ground, it also pointed out that Claim 1 did not comply with the requirements of Article 84 EPC, since it attempted to define the invention by the result to be achieved and also it did not contain all the technical features necessary to carry out the claimed

process. Furthermore, for the reasons given in the communication of 11 March 1991, Claims 1 to 10 and 12 to 19 lacked an inventive step (Article 56 EPC).

III. On 16 April 1992 a Notice of Appeal was lodged against that decision, together with payment of the prescribed fee. With the Statement of Grounds of Appeal received on 17 June 1992, the Appellant (Applicant) filed, as an auxiliary request, a set of eighteen claims.

IV. In reply to a communication from the Board dated 25 April 1995, in which several objections under Articles 54, 56, 84 and 123(2) EPC against the two sets of claims then on file were raised, the Appellant on 9 August 1995 and 22 January 1996 filed as further auxiliary requests two new sets of claims. During the oral proceedings held on 22 February 1996 the four requests were withdrawn and replaced by two new sets of claims as main (sixteen claims) and auxiliary (eight claims) requests.

Claim 1 of the main request reads:

"Process for producing a prepolymer suited for the manufacture of polyurethane/urea elastomers, wherein toluenediisocyanate is reacted with a long chain polyol to produce a prepolymer having a content of reacted 2,4-toluenediisocyanate-derived units in the range from 65 to 85% by weight, preferably 80% by weight, based on reacted toluenediisocyanate in the prepolymer, and a content of reacted 2,6-toluenediisocyanate-derived units in the range from 15 to 35% by weight, preferably 20% by weight, based on reacted toluenediisocyanate, and the prepolymer reacted with an aromatic diamine, characterized in that

(a) an isomer mixture of 2,4- and 2,6-toluenediisocyanate is reacted with a long chain diol at a temperature from 0 to 90°C and at a mole ratio of toluenediisocyanate to a long chain diol from 4 to 20:1,

(b) the 2,6-toluenediisocyanate isomer content in said isomer feed mixture is adjusted to a value within the range from 50 to 65% by weight, and

(c) the unreacted toluenediisocyanate is removed from the reaction product to a level of less than 0.15%,

to obtain a prepolymer having an oligomer content of less than 10% by weight."

Dependent Claims 2 to 8 refer to preferred embodiments of Claim 1. Independent Claim 9 is directed to a:

"Prepolymer derived from toluenediisocyanate and a long chain polyol wherein the content of reacted 2,4-toluenediisocyanate-derived units is from 65 to 85% by weight, preferably 80% by weight, based on reacted toluenediisocyanate in the prepolymer, the content of reacted 2,6-toluenediisocyanate-derived units is from 15 to 35% by weight, preferably 20% by weight, based on reacted toluenediisocyanate, the content of oligomers is less than 10% by weight, preferably less than 2% by weight, and wherein the unreacted toluenediisocyanate level is less than 0.1%."

Dependent Claims 10 and 11 refer to preferred embodiments of Claim 9.

Claim 12 refers to a process for manufacturing a polyurethane/urea elastomer in which a prepolymer reaction product of any of Claims 9 to 11 is reacted with an aromatic diamine.

Dependent Claims 13 and 14 are directed to preferred embodiments of Claim 12, and Claim 15 refers to a polyurethane/urea elastomer obtainable by the process of any of Claims 12 to 14. Claim 16 concerns the use of the prepolymers as produced according to Claims 1 to 8 and 12 to 14 for the manufacture of polyurethane/urea elastomers.

The auxiliary request consists of process Claims 1 to 8 of the main request.

V. The Appellant argued essentially as follows:

V.A In addition to the temperature of the reaction of the TDI isomer mixture with the long chain diol (feature (i)) and the low amount of unreacted TDI in the prepolymer (feature (v)), which could be regarded as conventional features for that type of reaction, the essential features of the process as claimed were:

- the ratio of TDI to diol in the reaction mixture should be from 4:1 to 20:1 (feature (ii)),

- the amount of 2,6-TDI in the isomer feed mixture should be from 50 to 65% by weight and the amount of 2,4-TDI in the isomer feed mixture should be from 35 to 50% by weight (feature (iii)),

- the amount of 2,6-TDI in the prepolymer product should be from 15 to 35% by weight and the amount of 2,4-TDI in the prepolymer product should be from 65 to 85% by weight (feature (iv)) and

- the content of oligomers in the prepolymer product should be below 10% by weight (feature (vi)).

During the oral proceedings the Appellant distributed two graphs showing the relationship between the amount of 2,4-TDI in the feed mixture and the amount of oligomers in the prepolymer product at varying TDI:diol ratios (Figure 3.14) and the content of 2,4-TDI in the prepolymer product as a function of the 2,4-TDI content in the feed mixture, also at varying TDI:diol ratios (Figure 3.13).

V.B As regards novelty, neither of D1 or D3 (US-A-4 556 703) disclosed the low oligomer content in the prepolymer (feature (vi)), which low content explained the advantageous properties of the elastomer made out of the prepolymer.

Also, D1 did not teach features (iii) and (iv), as the highest 2,6-TDI to 2,4-TDI feed ratio used was 35 to 65 (Example 10), which, as illustrated by Figure 3.14, could never result in a prepolymer having from 15 to 35% by weight of 2,6-TDI since that 2,6-TDI content was combined with a TDI to polyol ratio of 2 to 1.

Whereas D1 disclosed the use of lower amounts of 2,6-TDI than now required in the claimed subject-matter, D3, apart from the lower TDI to diol ratio, described the use of higher amounts of 2,6-TDI than now required in the claims, so that D3 likewise did not anticipate features (ii) to (iv). However, in response to a question of the Board, the Appellant

admitted that, as far as the prepolymer was concerned, the oligomer content was in fact the only difference between D3 and the claimed subject-matter.

V.C As regards inventive step, the Appellant stated that the object of the invention was to define a process for the preparation of a prepolymer that gave rise to a polyurethane with superior properties. In particular, a high temperature tensile strength as well as a low hysteresis and heat buildup were aimed at.

The object of D1 differed from the present one as it referred to a higher reactivity of the prepolymer mixture, leading to shorter moulding times of the polyurethane formed, and therefore that citation could not contain any hint at improving hysteresis. D3 on the other hand, was aimed at solving the same problem as the application in suit, but it provided a different solution, since the amount of 2,6-TDI was higher than the amount now required in the claims and the 2,6-TDI in excess would have to be removed in order to arrive at the present ratios. Therefore, starting from D1 as the closest prior art document, although D3 did teach that a higher amount of 2,6-TDI resulted in improved heat buildup, it did not suggest that the present specific amount of 2,6-TDI would lead to the unexpectedly improved properties as demonstrated in the examples of the application as well as in the additional experiments filed on 16 July 1991 and with the Appellant's submission of 22 January 1996.

V.D In its final submissions during oral proceedings the Appellant emphasised that the special merit of the claimed process was the ability to use a commercially available feedstock with a ratio of 2,6-TDI to 2,4-TDI of 20 to 80. This isomer mixture was used in the feed of a first reaction, and, since the reactivity of the 2,4-TDI isomer with the diol was greater than that of the 2,6-TDI isomer, the mixture of unreacted components contained more 2,6-TDI than the original isomer feed mixture. That high content 2,6-TDI mixture, if desired adjusted to a different 2,6-TDI to 2,4-TDI ratio by means of mixing with the commercial feedstock, was then used in excess to the diol as the feed of a second reaction, which resulted in a prepolymer product having the low oligomer content responsible for the advantageous properties of the elastomer made out of the prepolymer. By "oligomers" byproducts were meant that contained TDI-derived units and diol-derived units in a ratio of less than 2:1.

VI. The Appellant requested that the decision under appeal be set aside and a patent be granted on the basis of Claims 1 to 16 filed on 22 February 1996 as the main request, or, alternatively, on the basis of Claims 1 to 8 filed on 22 February 1996 as an auxiliary request.

**Reasons for the Decision**

1. The appeal is admissible.

*Procedural matters*

2. The Appellant's professional representative was accompanied by an American patent attorney and an American technical expert in addition to his unqualified assistant. Right at the outset of the proceedings the representative announced his intention to let the American patent attorney present the bulk of the case on the ground that he was the person most familiar with the invention. The Board explained that pending the issuance of a number of relevant cases pending before the Enlarged Board, the well established rules as set out in Articles 133 and 134 EPC needed to be followed. After a number of questions put to the American patent attorney by the Board it became apparent that he had no right of audience before the EPO nor of course did the unqualified assistant. It was further pointed out to all persons present on behalf of the Appellant, that technical evidence could be adduced both by the American technical expert as well as the American patent attorney insofar as such evidence confined itself to an explanation or clarification of the technical details of the invention as filed, as well as any matters directly relevant thereto. It was pointed out by the Board that evidence within the context of Article 117 EPC in effect meant all the legal means excluding mere argument that tended to prove or disprove a fact at issue, namely one submitted to the judicial investigation and decision of the Board. It was stressed that evidence did not include the making of legal submissions or the making of requests.

The technical expert and the American patent attorney then proceeded to explain and clarify a number of the essential features of the alleged invention. Later on during the course of the proceedings the technical expert also gave evidence on the significance and interpretation of two graphs that had been produced by the professional representative's assistant designed to prove the technical advantages of the alleged invention. The professional representative then proceeded to submit the Appellant's case on the two issues before the Board, namely novelty and inventive step.

*Article 123 EPC*

3. The wording of the claims of both the main and the auxiliary requests does not give rise to any objections under Article 123(2) EPC for the following reasons.

Claim 1 is based on claim 1 as originally filed. It differs from it in that the requirements described above (see point V.A) under features (iii), (iv) and (vi) have been added. These amendments find their basis in the application as originally filed: feature (iii) on page 6, lines 24 to 25 and page 8, lines 19 to 20; feature (iv) in the combination of Claims 4, 9 and 11 and on page 6, lines 26 to 28 and page 8, lines 20 to 21 of the description; feature (vi) on page 6, line 11.

Claims 2, 3 and 5 to 8 are based on Claims 2, 3 and 5 to 8 as originally filed; Claim 4 on page 6, lines 16 to 22, of the original description.

Claim 9 is based on Claim 10 as originally filed. It differs from it in that the requirement described above under feature (iv) (see point V.A) has been added and feature (vi) has been reformulated. These amendments find their basis in the application as originally filed:

feature (iv) in the combination of Claims 4, 9 and 11 as well as on page 6, lines 26 to 28 and page 8, lines 20 to 21 of the description; feature (vi) on page 6, line 11.

Claim 10 is based on original Claims 6 to 8, Claim 11 on page 5, line 25 of the original description, Claim 12 on the combination of original Claims 1 and 13 and page 6, lines 29 to 30, Claim 13 on original page 6, lines 30 to 33, Claim 14 on original page 6, line 31 and Examples 8 to 22 and 24 to 38, Claim 15 on original page 1, lines 2 to 4, and Claim 16 on page 4, lines 31 to 35 of the original description.

*Article 84*

4. As it appears from point V.A above, process Claim 1 contains not only true process features (i), (ii) and (iii), but also product features (iv), (v) and (vi), so that the process is partially defined by the result to be achieved.

4.1 From the present description and the Appellant's submissions, it however appears that the process and product features are interrelated. In particular, the low amount of oligomers (feature (vi)) is achieved by using a high TDI:diol ratio (feature (ii)) (see e.g. the original description, page 7, lines 2 to 6, illustrated by Figure 3.14 filed during the oral proceedings), which effect is also influenced by the temperature (feature (i)) (page 7, line 25 to page 8, line 11 of the original description). Similarly, the high content of 2,6-TDI in the prepolymer (feature iv)) is a direct consequence of the high amount of that isomer in the feed (feature (iii)) (see e.g. page 8, lines 12 to 21 of the original description). Finally, removal of unreacted TDI resulting in a low residual amount of unreacted TDI

(feature (v)) is, in the light of both D1 (page 12, lines 9 to 15) and D3 (column 6, lines 20 to 22) as well as the original description, page 8, lines 22 to 24, a normal procedure in this kind of reaction, so that this feature, too, is sufficiently clear.

4.2 Although the word "oligomers" is not defined in the original application, according to the Appellant's explanation at the oral proceedings, it refers to undesired by-products of the TDI/diol reaction corresponding to reaction products of TDI and diol in a molar ratio lower than the theoretical ratio 2:1, in particular the adducts 3:2 and 4:3. Such by-products are also described in D1, page 12, lines 3 to 9, and thus represent well-known and well-defined compounds. As the upper limit of their content in the prepolymer (feature (vi)) must be regarded as the direct consequence of the features (i) to (iii) being controlled throughout the process, neither from a qualitative viewpoint, nor from a quantitative viewpoint the presence of this feature expressing the result to be achieved can be objected to.

4.3 For these reasons, the Board is satisfied that the requirements of Article 84 EPC are met.

*Novelty*

5. The amendments in Claim 9 (Claim 11 as refused) overcome the objection of lack of novelty raised with respect to the teaching of D1.

5.1 This citation discloses a process for the production of polyurethane urea elastomers by reacting (a) a prepolymer prepared from a high molecular weight polyhydroxy compound and a molar excess of a polyisocyanate selected from TDI, phenylene diisocyanate

and/or hexamethylene diisocyanate, (b) minor amounts of a tetraalkyl substituted diphenylmethane diisocyanate, wherein the alkyl groups are in the ortho position with respect to the isocyanate groups, and (c) an alkyl substituted aromatic diamine (Claim 1). The prepolymer used in Examples 10 to 13 is obtained at 80°C from 2 moles of an isomer mixture of 2,4- and 2,6-TDI in the molar ratio 65:35 and 1 mole of a polyesterdiol (page 27, lines 6 to 12 in conjunction with page 19, line 9). Neither the broad definition of the prepolymer (a) in Claim 1, nor the specific prepolymer of Examples 10 to 13 correspond to the combination of features required in Claim 9; in particular, there is no explicit mention of product features within the terms of features (iv) to (vi) above, so that novelty can be acknowledged on the basis of these differences.

5.2 Although the novelty issue in the impugned decision had not been raised in relation to D3, during the oral proceedings it appeared that in fact this document was more relevant than D1 as far as the product claims were concerned.

D3 discloses a process for preparing TDI-based castable polyurethane elastomers having low heat buildup characteristics by reacting (a) a polyurethane prepolymer formed from a polymeric diol and a stoichiometric excess of 2,6-TDI used in the form of a mixture of 2,6-TDI and 2,4-TDI in the ratio of 50:50 to 90:10 (Claim 1) or containing at least about 40% 2,6-TDI based on the weight of the isomeric mixture (Claim 20), (b) an aromatic diamine and (c) optionally a catalyst. The ratios of 2,4-TDI to 2,6-TDI in the examples are 80:20 (Examples 1 and 3), 39:61 (Example 2) and 45:55

(Examples 4 to 6) and the reaction is carried out at a temperature of initially 95°C, and then 65°C (column 6, lines 16 to 18). No specific diol/TDI ratio is mentioned, but in all examples it is about 2:1.

The discussion during oral proceedings made it clear that, because of the difference in reactivity with hydroxyl groups between 2,6-TDI and 2,4-TDI isomers, the monomer feed used in D3, which is within the terms of feature (iii), would be expected to give rise to a prepolymer having a 2,6-TDI isomer content within the terms of feature (iv). This means that the latter cannot be regarded as an independent parameter for the definition of the prepolymer; on the contrary, it is the direct consequence of operating in accordance with feature (iii) and as such it cannot contribute to the novelty of the prepolymer. However, in view of the low TDI/diol ratios disclosed in D3, the amount of oligomers would be above the limit now required in the claims (see the analysis in point 4.2 above), so that feature (vi) cannot be regarded as implicitly disclosed and novelty can be acknowledged on the basis of this difference.

5.3 The issue of novelty has not been raised with respect to the process claims and, also in view of the above analysis of the prior art, the Board concludes that the requirements of Article 54 EPC are met.

*Problem and solution*

6. The application in suit concerns a process for the preparation of polyisocyanate prepolymers and polyurethanes having high temperature performance and low hysteresis.

6.1 As stated above (point 5.1), such a process is disclosed in D1, in particular in the preparation of the prepolymer used in the Examples 10 to 13, which the Board regards as the closest state of the art. According to that embodiment a mixture of 2,4-TDI and 2,6-TDI in a ratio of 65 to 35 is reacted with a polyester diol in a ratio of 2:1 at a temperature of 80°C.

6.2 According to the introduction of the application in suit and in the light of the Appellant's submissions during the oral proceedings the technical problem underlying the application in suit may be seen in the definition of a process for the preparation of a polyisocyanate prepolymer giving rise to a polyurethane having improved tensile strength as well as low hysteresis and heat buildup properties.

6.3 According to the application in suit this problem is solved by reacting a large molar excess of a specific mixture of 2,4- and 2,6-TDI isomers with a high molecular weight diol, and then removing the unreacted TDI to a certain level, whereby a prepolymer having an oligomer content lower than 10% by weight is obtained, as specified in Claim 1.

6.4 In view of (a) the examples in the application in suit, (b) the additional experiments filed on 16 July 1991 and 22 January 1996 and (c) the graphs submitted during the oral proceedings, the Board is satisfied that the combination of features of the process as defined in Claim 1 provides an effective solution to the above-defined technical problem.

*Inventive step*

7. It remains to be decided whether this combination of features is obvious having regard to the prior art.

7.1 The preferred embodiments in D1 show that features (ii), (iv) and (v) are obvious in order to achieve good mechanical properties.

7.1.1 The main feature of the process disclosed in D1 is the presence of a specific diisocyanate (b) together with the prepolymer (a), by which both the reactivity and the isocyanate content of the prepolymer are increased (page 1, line 1 to page 2, line 5). Whereas the use of a mixture of different diisocyanate components in the preparation of polyureas would, as the result of the presence of different urea segments in the polymer chain, normally be expected to have a detrimental effect on the mechanical properties of the polymer, this does not occur in D1 as long as the additional diisocyanate (b) meets specific structural requirements (page 5, lines 9 to 23).

7.1.2 This general statement regarding the negative influence of different urea segments on the properties of polyureas is a warning against the presence of different reactive entities and therefore it is an incentive for a skilled person to limit the chain extension mechanism to one specific reaction. In particular, as shown below (point 7.1.3) the formation of oligomers, which are reactive condensation products of TDI and diols in molar ratios lower than the theoretical value of 2:1 and which are normally formed as by-products in the preparation of the prepolymer, should be avoided.

7.1.3 Although the molar ratio diisocyanate:diol in the prepolymer is 2:1, the reaction of preparation of the prepolymer is preferably carried out with a large excess of diisocyanate, e.g. up to 10:1 (feature (ii)), the excess of diisocyanate being removed subsequently by distillation to a content lower than 0.2 percent by weight, preferably lower than 0.05 present by weight (feature (v)). This has the advantage that side reactions involving a relatively high number of moles of diol are to a large extent avoided and that prepolymer formation practically occurs on the basis of the ideal 2:1 ratio (page 11, line 21 to page 12, line 15). In the light of paragraph 7.1.1 this is essential, because adducts resulting from such side reactions would inevitably give rise in the presence of diisocyanate in excess to different isocyanate oligomers, which in turn would be incorporated in the polymer chain as an urea segment different from the basic unit, with consequently all the detrimental effects on the mechanical properties mentioned before.

7.1.4 These considerations show that, according to the information contained in D1, a low amount of oligomer is to be expected when a large amount of TDI is used. The range specified in Claim 1 (feature (vi)) is thus to be regarded as the direct consequence of operating according to feature (ii), which means that it does not represent an additional characterisation of the prepolymer, but merely is a superfluous product feature. This conclusion is in line with the explanations given in the application in suit (page 4, lines 15 to 23), according to which the amount of oligomers formed increases when the ratio TDI:polyol decreases and comes closer to the stoichiometric value.

7.1.5 Summarizing, the necessity to control the specificity of the reaction by which the prepolymer is formed in order to achieve good mechanical properties renders obvious features (ii), (v), and (vi).

7.2 As stated above (point 5.2), D3 is concerned with the preparation of a polyurethane elastomer having low heat buildup characteristics by reacting (a) a polyurethane prepolymer formed from a diol of high molecular weight and a stoichiometric excess of TDI used in the form of a mixture of 2,6- and 2,4-isomers, (b) an aromatic diamine, and (c) optionally a catalyst. Following the preparation of the prepolymer, which takes place at a temperature between 65 and 95°C, the prepolymer is passed through a heated thin-film distillation apparatus to remove most of the residual TDI (column 6, lines 15 to 21); this confirms that features (i) and (v) are usual for this particular reaction. Further, the expression "low heat buildup characteristics" is explicitly said to mean "that the polyurethane elastomer compositions formed from the prepolymers ... exhibit a lower heat buildup under corresponding test or use conditions than polyurethane compositions based on an 80%/20% 2,4/2,6-isomeric mixture of tolylene diisocyanate or based on 100% 2,4-tolylene diisocyanate" (column 3, lines 4 to 10).

7.2.1 In other words, the advantageous low heat buildup characteristics are directly related to the use of a TDI feed having a high 2,6-isomer content (feature (iii)). This clearly appears from a comparison of the wheel load values of various polyurethanes obtained from different TDI isomer compositions (column 8, Table I; column 9, Table II); the compositions with the higher 2,6-TDI isomer content (Example 2: 61%; Examples 4 to 6: 55%) yield wheels which can carry a greater load (1030 resp. 930/950/960 lbs.) before reaching the same temperature

as a wheel made from compositions not pursuant to the teaching of D3 (Examples 1 and 3: 20%; 880/600 lbs.), which demonstrates both superior dynamic properties and lower hysteresis (column 7, lines 6 to 16; column 7, lines 58 to 67; column 9, lines 35 to 40; Figure 1).

7.2.2 As stated above (see point 5.2), feature (iv) cannot be regarded as an independent parameter in the characterization of the prepolymer as it is derived directly from operating in accordance with feature (iii) and as such it cannot contribute to the inventiveness of the process.

7.2.3 D3 thus provides a clear teaching that heat buildup properties and hysteresis of polyurethanes derived from TDI isomer mixtures can be improved by increasing the 2,6-TDI isomer content of the TDI feed to more than 50% in the preparation of the prepolymer (feature (iii)).

7.3 The discussion of the prior art has brought to light that the process as defined in present Claim 1 combines features which are closely related to mechanical properties (features (ii), (v) and (vi)) with features which are closely related to heat buildup characteristics and hysteresis (features (iii) and (iv)), and that in view of the teaching of D1 and D3 both categories of features are obvious for the solution of the above-defined technical problem. It follows that the claimed subject-matter does not involve an inventive step.

7.4 The arguments presented by the Appellant in its final submission during oral proceedings (cf. point V.D above) concerning an advantageous embodiment allowing the use of a commercial TDI feedstock in a continuous process is

not reflected in the wording of the main process claim and consequently cannot be taken into account in favour of an inventive step.

7.5 Claim 1 not being allowable, the same applies to dependent Claims 2 to 8 which are directed to preferred embodiments of the main process claim and thus fall with it.

The patentability of (a) the prepolymer as defined in claims 9 to 11, (b) the preparation of a polyurethane/urea elastomer therewith (Claims 12 to 14 and 16) and (c) the polyurethane/urea elastomer itself (Claim 15) need not be considered, since a request can only be considered as it stands.

8. For these reasons, the main request as well as the auxiliary request, the latter consisting of process Claims 1 to 8 only, have to be rejected.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar: The Chairman:

E. Görgmaier C. Gérardin